II Semester 2003-2004

PHYCS 102, Test 1 dated 12/4/04

Solution to Test 1

Q1: $F = kQ^2/a^2 = 10^{11}\ Q^2 \quad , \quad F_{tot} = \sqrt{2} \times 10^{11}\ Q^2$

$F_{tot} = 0.1414\ Q^2(\mu c) = 14.2\ ,\ 31.8\ ,\ 56.6,\ 88.4\,N$

Q2: $V = \sum_i \frac{kQ_i}{r_i} = 9\times10^9\ \frac{Q(nc)\times10^{-9}}{0.3}\left(-1 + \frac{2}{\sqrt{2}}\right) = 12.426\ Q(nc)$

$= 124.3,\ 186.4,\ 248.5,\ 310.6V$

$eV = \frac{1}{2}mv^2 \ \ \therefore v = \left[0.3516\times10^{12}\ V\right]^{1/2} = 1.18\times10^7\,m/s,\ 1.77\times10^7\,m/s,$

Q3: $2.37\times10^7\,m/s,\ 2.96\times10^7\,m/s.$

$\lambda = 2\pi a\sigma\ ,\ E = \frac{2k\lambda}{r} = \frac{200}{r} = 200,\ 250,\ 400,\ 500\,N/C$

Q4:

Q5

$$C_{eq} = \left\{ c \quad (ser)\left[15\mu F\,(par)\left(\underbrace{10\mu F\,(ser)\,10\mu F}_{5\mu F} \right) \right] \right\} = \frac{20c}{20+c} = 4,\ 7.5,\ 10,\ 15\mu F.$$

Q6: $Q_1 = c_1 \times 10 = 20\mu C,\ Q_2 = 10c_2,\ Q_{net} = 10c_2 - 20\mu$

$$\left.\begin{array}{l} 10c_2 - 20\mu = Q_1^{'} + Q_2' \\ \frac{Q_1'}{2\mu} = \frac{Q_2'}{c_2} \end{array}\right\} Q_1' = 6.66,\ 10,\ 12,\ 13.33\mu C$$

Problem 1: $E_\rho = k\int_b^{-\infty} \frac{\lambda dy}{y^2} = \frac{k\lambda}{b} \ \ or \ \ E_\rho = k\int_o^{-\infty} \frac{\lambda dy}{(b+y)^2} = \frac{k\lambda}{b}$

Problem 2:

I **1-** $E_1 = k2Q/r^2$

2- $E_2 = 0$

3- $E_3 = 0 \ \left(q_{encl} = 0\right)$

II $$V_p = V_{p\infty} = \int_a^{\infty} E dr = \int_a^b E_1 dr + \int_b^c E_2 dr + \int_b^c E_3 dr = 2kQ\left(\frac{1}{a} - \frac{1}{b}\right)$$

III $$V = V_p = 2kQ\left(\frac{b-a}{ab}\right) \therefore C = \frac{2Q}{V} = \frac{ab}{k(b-a)}$$
